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***Nuclear Energy Readiness Indicator Index (NERI): A  
benchmarking tool for assessing nuclear capacity in  
developing countries***

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Nuclear Energy Readiness Indicator Index (NERI):  
A benchmarking tool for assessing nuclear capacity in developing countries<sup>1</sup>

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Declining natural resources, rising oil prices, looming climate change and the introduction of nuclear energy partnerships, such as GNEP, have reinvigorated global interest in nuclear energy. The convergence of such issues has prompted countries to move ahead quickly to deal with the challenges that lie ahead. However, developing countries, in particular, often lack the domestic infrastructure and public support needed to implement a nuclear energy program in a safe, secure, and nonproliferation-conscious environment. How might countries become ready for nuclear energy?

What is needed is a framework for assessing a country's readiness for nuclear energy. This paper suggests that a Nuclear Energy Readiness Indicator (NERI) Index might serve as a meaningful basis for assessing a country's status in terms of progress toward nuclear energy utilization under appropriate conditions.

The NERI Index is a benchmarking tool that measures a country's level of "readiness" for nonproliferation-conscious nuclear energy development. NERI first identifies 8 key indicators that have been recognized by the International Atomic Energy Agency as key nonproliferation and security milestones to achieve prior to establishing a nuclear energy program.<sup>2</sup> It then measures a country's progress in each of these areas on a 1-5 point scale. In doing so NERI illuminates gaps or underdeveloped areas in a country's nuclear infrastructure with a view to enable stakeholders to prioritize the allocation of resources toward programs and policies supporting international nonproliferation goals through responsible nuclear energy development.

On a preliminary basis, the indicators selected include: 1) demonstrated need; 2) expressed political support; 3) participation in nonproliferation and nuclear security treaties, international terrorism conventions, and export and border control arrangements; 4) national nuclear-related legal and regulatory mechanisms; 5) nuclear infrastructure; 6) the utilization of IAEA technical assistance; 7) participation in regional arrangements; and 8) public support for nuclear power.

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<sup>2</sup> "Milestones in the Development of a National Nuclear Power Infrastructure," IAEA Nuclear Energy Series, No. NG-G-3.1, 2007.

In this paper, the Index aggregates the indicators and evaluates and compares the level of readiness in seven countries that have recently expressed various degrees of interest in establishing a nuclear energy program.<sup>3</sup>

The NERI Index could be a valuable tool to be utilized by: 1) country officials who are considering nuclear power; 2) the international community, desiring reassurance of a country's capacity for the peaceful, safe, and secure use of nuclear energy; 3) foreign governments/NGO's, seeking to prioritize and direct resources toward developing countries; and 4) private stakeholders interested in nuclear infrastructure investment opportunities.

### Demonstrated Need

The NERI Index captures demonstrated need by examining such indicators as a country's Gross Domestic Product (GDP), economic growth rates, and electricity demand. It also takes into account accessibility to fossil fuels and the impact that diminishing energy supplies have had on a country's citizens. For example, in the past several years, citizens in a number of developing countries have experienced sharp rises in fuel prices and electricity shortages, sparking mass demonstrations, violence and in some cases, death.

Governments that cannot provide an environment in which adequate energy is supplied hamper economic growth and threaten political stability. Thus the pressure to satisfy increasing demand for energy may indicate that officials will be more responsive to considering alternative sources of power, including nuclear energy.

The NERI Index ranks a country's demonstrated need based on a combined assessment of these factors using a scale of 1-5, where:

1=little need

3=moderate need

5=strong demonstrated need

### Political Support

Demonstrated need must be backed by strong and consistent political support at the highest levels of government. It is essential that government officials declare their commitment to developing a nuclear energy program and spell out their intentions in a clearly mapped out long term energy plan. The energy plan should articulate intentions to develop only peaceful uses of nuclear energy and demonstrate that officials are prepared and capable of providing a safe and secure environment in which to do so.

Public declarations of political support form the basis of a credible national position to develop a nuclear energy program. Such statements hold officials accountable for their actions and reassure the international community of the government's commitment to become responsible custodians of nuclear technology. Publicly declared political support may also help convey that leaders will be open and transparent regarding their country's

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<sup>3</sup> While the countries examined are not identified in this paper they represent a range of "readiness."

nuclear activities, which serves to allay both regional and international concerns about a country's intentions.

The NERI Index ranks a country's political support on a 1-5 scale, based on the quality and consistency of political statements made about nuclear energy by senior government officials. Political support is measured as follows:

1=little political support    3=moderate political support    5=strong political support

### Nonproliferation and Nuclear Security Commitments

Becoming an NPT party and concluding a comprehensive safeguards agreement (CSA) are the *sine qua non* to establishing a nuclear energy program under conditions that provide critical assurance of peaceful use. The conclusion of an IAEA Additional Protocol further builds mutual confidence and demonstrates states' commitments to internationally accepted nonproliferation norms. Indeed, President Bush proposed in 2004 that "only states that have signed the Additional Protocol be allowed to import equipment for their civilian nuclear programs."

Policy makers further signal their intentions to provide a safe and secure environment for nuclear energy by participating in other treaties, conventions and agreements such as: the Convention on the Physical Protection of Nuclear Material (CPPNM) and its recent amendment, the Convention on Nuclear Safety (CNS), the Comprehensive Nuclear Test Ban Treaty (CTBT), and regional agreements such as the Treaty on the Southeast Asia Nuclear Weapon-Free Zone (Bangkok Treaty).

A country's participation in major International Terrorism Conventions serves as an indicator of its readiness to prevent, deter, and punish terrorist activities. The Convention on the Physical Protection of Nuclear Material, and its recent amendment, and the 2007 International Convention for the Suppression of Acts of Nuclear Terrorism are examples that relate directly to potential dangers that might arise in countries that possess nuclear material.

Adherence to the principles of UNSCR 1540 elucidates the level of commitment to sound systems of control on relevant nuclear related commodities, including export control policies. Participation in export control arrangements, such as the Zangger Committee or the Nuclear Suppliers Group, also demonstrates that a country recognizes the importance of controlling, monitoring, and documenting the transfer of nuclear material, equipment, and technology.

Participation in bilateral arrangements such as the U.S.-led Megaports Initiative or Container Security Initiative suggests that the country is addressing maritime security to deny proliferators transit and sanctuary at sea. Sharing information regarding nuclear smuggling with the International Tracking Database (ITDB) further demonstrates a country's commitment to prevent and deter proliferation activities.

It is important to note that becoming a signatory to such arrangements is a necessary, but not sufficient indicator of a country's willingness or ability to comply with internationally recognized safeguards, safety, and security norms. (Bringing these agreements into force and putting in place the appropriate legal instruments and infrastructure to implement these commitments is a key factor that will be discussed below). Nonetheless, examining the treaties, conventions and agreements in which a country participates sheds light on the country's willingness to abide by its international safety and security obligations.

The NERI Index factors in a country's status with respect to relevant treaties, conventions and agreements, with a view to illuminate the level and scope of its commitment to international nonproliferation and safety norms. Treaty participation is measured as follows:

1=minimal participation      3=moderate participation      5=strong participation

#### National Legal Mechanisms

Countries preparing for nuclear energy should enact a comprehensive set of atomic laws and nuclear-related regulations and establish an appropriate regulatory function. A country must also update penal codes and enable law enforcement to detain and punish transgressors effectively and in an efficient manner, including the allocation of liability in the event of a nuclear accident.

The NERI Index assesses the quality of national nuclear-related legal mechanisms by determining if countries have enacted and effectively implemented laws covering safety, security, liability, and commercial aspects of a nuclear energy program. A country that has adopted and implanted such legal mechanisms signals that it is aware of its responsibilities and up to the challenge of maintaining a safe and secure nuclear energy program.

Legal mechanisms are measured as follows:

1=minimal level      3=moderate level      5=strong level

#### National Infrastructure

The NERI Index factors in the existence (or lack thereof) of the necessary infrastructure to sustain a nuclear energy program. It evaluates national nuclear institutions such as the country's atomic energy commission, and examines its ability to formulate policy, and oversee the general direction of civilian nuclear technology use within the country.

It also examines whether a country has an independent regulatory body, and evaluates its State System of Accounting and Control (SSAC), national nuclear research centers, and radioactive waste facilities.

NERI further considers the amount of available human resources to manage, operate, maintain, and regulate a nuclear energy program. Additionally, it takes into account a country's electrical grid capacity to determine if nuclear power is a feasible option given electricity-generating constraints.

All of these indicators help determine the status of existing national infrastructure. The combined amount of infrastructure is measured as follows:

1=minimal amount

3=moderate amount

5=large amount

#### IAEA Technical Assistance

Though a developing country might not yet have the necessary infrastructure in place, it may have enlisted IAEA support to help build its capacity. The Agency's Technical Cooperation (TC) Programme offers a wide variety of technical assistance, from agricultural projects like "Mutation Breeding of Horticultural Crops", to medical applications like "Strengthening Medical Physics through Education and Training." The TC Programme also supports nuclear energy-specific projects such as nuclear power feasibility studies, assistance in the preparation of regulatory frameworks, and human resource training and development.

NERI examines the type of TC projects conducted within a country. This element of NERI is an indicator of preparedness and intent, the former because the TC projects build relevant capacity and the latter because States that choose nuclear energy related projects must reduce their TC activity in other areas. The percentage of nuclear energy-related projects is compared to the other types of TC assistance requested by the country and is measured as follows:

1=low percentage

3=moderate percentage

5=high percentage

#### Regional/ Bilateral/Private Industry Cooperation

Participation in regional networks gauges outreach as an indicator of interest in nuclear energy development. By providing educational, training and information exchange opportunities, regional nuclear networks promote cooperation, build trust, and help extend security assurances between neighboring countries. Some examples of nuclear networks in developing regions include: the South-East European Nuclear Physics Network, the Asian Nuclear Safety Network (ANSN), and the Regional Co-operative Agreement for the Promotion of Nuclear Science and Technology in Latin America (ARCAL).

A successful nuclear energy development program also depends on a country's ability to procure funding, resources, and other forms of support, typically through bilateral arrangements with countries that have well-established nuclear programs.

Additionally, private industry investment and financing arrangements by international organizations also help indicate the level of country preparedness.

The NERI Index combines the amount of regional participation in nuclear networks and bilateral and private industry cooperation as a single indicator and measures it as follows:

1=low level

3=moderate level

5=high level

### Public Support

In some countries, widespread opposition by environmentalists, religious groups and local citizens have had a negative impact. At times, it has played a part in pressuring governments to abandon the pursuit of nuclear power altogether. However, this indicator may not carry as much weight in countries with closed governments, where public expression is suppressed and plays a lesser role in determining a government's decisions. Consequently, the weight of this indicator may vary from country to country. In this preliminary example, it is measured equally to the previous indicators:

1=minimum public support

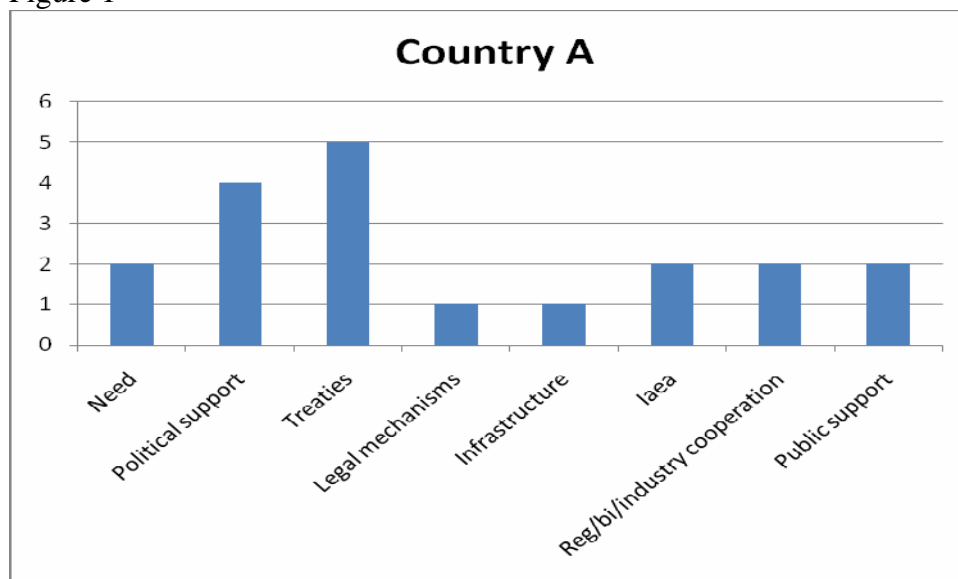
3=moderate public support

5=strong public support

### Visualization of NERI

The principle aim of the NERI Index is to help identify strengths and weaknesses in a country's nuclear power development program with a particular focus on nonproliferation. Figure 1 below offers an example of how the Index might look in a single country.<sup>4</sup>

Figure 1



<sup>4</sup> More might need to be said about the causal relationship—the fact that some of the indicators no doubt influence the others. For example, a low level of regional/bi/industry cooperation might be caused by, or at least related to, the fact that the country is lacking in declared political support. Nevertheless, treating the results of indicators separately may still prove useful in identifying areas requiring improvement.



The chart provides a sort of snapshot of development, or, a progress report for Country A. The results suggest that Country A is taking a top-down approach to nuclear energy development, adopting international treaties and declaring a significant amount of political support. However, it appears that the country lacks the domestic capacity to implement its international obligations. The chart indicates that Country A requires improved legal mechanisms and nuclear infrastructure. It further indicates that Country A received minimal IAEA technical support, which, if increased, might raise the level of progress in the other areas that signal readiness.

Applying NERI to a group of neighboring countries helps place a country's status in a regional context. A comparison of a country's NERI scores might look something like Figure 2 below.

Figure 2

NERI Indicator Scores								
Country	Need	Political Support	Int'l Treaties	Legal	Infra-structure	IAEA	Regional / Bilateral/ Private Industry Cooperation	Public Support
Country A	2	4	5	1	1	2	2	2
Country B	5	4	5	5	5	5	5	3
Country C	2	2	4	4	4	2	3	2
Country D	3	3	2	1	2	2	2	3
Country E	1	1	2	2	2	1	1	1
Country F	4	5	3	2	4	4	5	5
Country G	3	5	3	2	3	4	5	2

The breakdown in Figure 2 allows for a side-by-side comparison of countries across the eight indicator fields and depicts a wide range in terms of nuclear energy readiness across the countries assessed. In this regional example, Country B appears far more advanced in terms of most of the readiness indicators, however it still might seek improvements to its efforts to ramp up public support. In contrast, the Index illuminates weaknesses in every indicator field in Country E

Figure 3 below aggregates countries' scores in each indicator field and then ranks the 7 countries in terms of their overall readiness for establishing a nonproliferation-conscious nuclear energy program.

Figure 3

NERI Rankings	
Country	NERI RANKING (from most to least ready)
B	1
F	2
G	3
C	4
A	5
D	6
E	7

Figure 3 shows that, if all indicators are weighted equally, Country B is the most regionally prepared country for the introduction of nuclear energy. Country E is far less advanced and will likely require increased attention if it is to become ready to provide a secure and non-proliferation conscious environment for nuclear energy.

Whether the results suggest that efforts should be targeted toward the least or most prepared developing country is a policy question to be determined by stakeholders who are in a position to take action. Nevertheless, an assessment of the status of safeguards and other nonproliferation goals in the developing world will help the US, IAEA and other supplier countries to attain a comprehensive understanding of the nuclear-relevant needs of developing countries and help to determine where best to focus capacity-building, funding, and other program support activities.